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DMA (DEFENSE MAPPING AGENCY) POLICY FOR DIGITAL MC&G
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HYDROGRAPHIC/ TOPOGRAPHIC CENTER WASHI. B D SHELKIN
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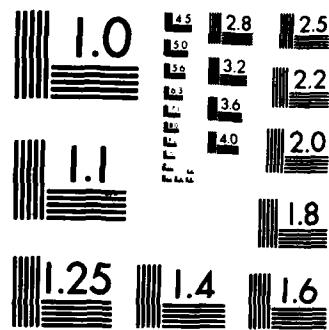
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DEFENCE MAPPING AGENCY (DMA) POLICY FOR
DIGITAL MAPPING, CHARTING AND GEODESY
(DMCG) SUPPORT OF ADVANCED SYSTEMS

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ABSTRACT

The rapid expansion of requirements for digital MC&G products to support advanced weapon systems has required DMA to reevaluate its digital data policy. The Agency is being called upon to produce a variety of digital products which are vital to the successful employment of a wide range of weapon systems and training devices. In the next few years, the DMA level of effort will grow to encompass such diverse applications as advanced guidance systems, avionics support, situation displays for C³I and sensor strike, automated hydrographic navigation and digital flight information. In order to meet these requirements DMA must offer flexible, efficient and effective digital MC&G products. This presentation spells out DMA's objectives in the digital MC&G area and details specific methodology for reaching those objectives. The basis of this policy is the standardization and concurrent enhancement of the Digital Landmass System (DLMS) data base. DMA's efforts to upgrade the capability, coverage, applicability and access of digital data are spelled out. For the long-term, DMA's goal is to develop multiple-use data files through a prototype product evaluation program with active user participation.

I. INTRODUCTION

It is the responsibility of the Defense Mapping Agency (DMA) to provide mapping, charting, and geodesy (MC&G) support to the United States Military Services in the form of paper products such as topographic maps, hydrographic charts, and Flight Information Publications. These are still vital elements for the successful employment of air, land, and sea forces. During the past ten years, however, there has been a large increase in the requirement for MC&G support for digital map products. DMA is now being called upon to produce a variety of digital products vital to such diverse fields as weapons guidance, sensor simulation, situation display, advanced avionics, automated hydrographic navigation, and mission planning.

It is the purpose of this presentation, therefore, to indicate specific DMA strategies to support digital MC&G requirements for the near-term, as well as for the outer years.

More demanding mission requirements, for example, are driving the avionics community to develop increasingly sophisticated technology to ease aircrew workload while increasing aircraft effectiveness. This advanced avionics technology demands a new family of digital products containing map information which cannot be derived from the traditional paper map or chart. Accurate digital terrain matrices are needed to update inertial navigation systems (INS) and terrain following/terrain avoidance (TF/TA) systems, while detailed feature data in digital format are required for

sensor correlation and in-cockpit map displays. The successful employment of digital MC&G data is totally dependent on the quality, flexibility, and most of all, availability, of that data. In this respect, DMA is modernizing its production capability and procedures in order to be more responsive to rapidly expanding digital requirements. The user community must understand, however, that DMA's capability to produce digital MC&G data is limited to its available resources.

II. DIGITAL MC&G DATA

Any feature on a traditional map or chart can be portrayed in digital format. Terrain, cultural, and physical features can be described, quantified, and organized in standardized file structures allowing collection, storage, retrieval, and manipulation of MC&G data in a fully automated environment. These features can also be stored as numerical values in a geographically defined matrix, or portrayed as point, line, and area data sets positioned by a string of geographic coordinates. Terrain elevation, usually portrayed as contour lines on the topographic map, is best depicted as an array of data posts providing latitude, longitude, and elevation values evenly spaced on a matrix. Features such as drainage, roads, and vegetation, which are more difficult to define on a trend surface, can be depicted as a series of vectors and delta values originating from a coordinate set and associated feature descriptor. Regardless of its storage mode digitized map data can be rapidly accessed and

processed to provide information in a wide variety of formats. It is the ability to interact digital MC&G data with hardcopy cartographic data that has opened a new realm of applications to meet the needs of the user community. The table provides a broad reference to DMA digital products.

DMA also produces a number of small, special purpose, non-standard digital data files, such as the Navy's 15F12 Radar Navigation Trainer and the Army Training Battlefield Simulation System (AKTBANS). DMA is however, attempting to phase out such special digital map support in favor of a common, standardization data base by 1988. Non-standard product will be validated only in extreme cases.

DMA Digital Products					
PRODUCT	DIGITAL TERRAIN ELEVATION DATA (DTED)	DIGITAL FEATURE ANALYSIS DATA (DFAD)	TERRAIN CONTOUR MATCHING (TERCOM)	VERTICAL OBSTRUCTION DATA (VOD)	DIGITAL LANDMASS BLANKING DATA (DLMB)
Salient Features	Continuous Terrain	Radar Significant Features	Discontiguous Terrain	Tall features	Contiguous Shoreline
Format	Matrix	Vector	Matrix	Vector	Matrix
Granularity	3 arc-second (100 meters)	Nominal minimum 500' X 500'	various size matrices	minimum 120' Hihg	3 arc second (100 meters)
Product Unit Size	1° Lat x 1° Long	1° Lat X 1° Long	various size map sets	1° Lat X 1° Long	1° Lat X 1° Long
Stated Horizontal Accuracy	130m 90% WGS-72	130m 90% WGS-72	-	130m 90% WGS-72	170 ft 90% WGS-72
Stated Vertical Accuracy	± 30m 90% MSL	± 30m 90% MSL		120 ft, Point Obstr	NA
Requirement Area	31.5 Million Sq. Naut. Miles	27 Million Sq. Naut. Miles	-	1.54 Million Sq. Naut. Miles	Entire Global Coastline (ex. Antarctica)
Completed Area	17 Million Sq. Naut. Miles	6.5 Million Sq. Naut.. Miles	-	500 Thousand Sq. Naut. Miles	Approx 40% Global Coastline
Applications	Mission Planning Intervisibility Pass Loss/Line of Sight Contouring Profiling Terrain Simulation	Simulation Correlation Guidance Mission Planning	Navigation Guidance	Mission Planning	Radar Masking Mission Planning

III. THE DIGITAL LANDMASS SYSTEM (DLMS)

DLMS is the standard multi-use data base which will be employed in support of the majority of requirements for digital MC&G products for the remainder of the decade. DLMS is composed of two separate data files; Digital Terrain Elevation Data (DTED), and Digital Feature Analysis Data (DFAD). DTED is the terrain component and consists of a matrix of posts defining terrain elevation values at approximately 100-meter intervals on the earth's surface. DFAD is depicted as point, area, and line features in a separately maintained file. Although the two data bases are produced, stored, and maintained separately, they are compiled to the same control (World Geodetic System 1972) and positioned on a common source to ensure correct registration.

While capable of being used with the DFAD as a component of DLMS, DTED is often employed by itself. This terrain file is DMA's largest, and most used digital product due to its simplicity, flexibility, availability, and overall utility.

The feature component of DLMS is always used in concert with the terrain data. DFAD, while arranged in the same even one degree by one degree geographic areas as DTED, is not stored in raster (matrix) format. Feature portrayal in this file consists of a descriptive header record, a data set identification record, an accuracy record, and one or more feature records which contain digitally encoded descriptive information about each feature as well as defining the spatial configuration (point, line, area) of that feature.

The DLMS product specification defines in great detail which features will be collected and stored in the file. As DLMS was originally conceived as a radar simulation data base, feature portrayal is centered on its surface material category (i.e., radar reflectivity). Despite the seeming complexity of the specification, DFAD does have a reasonable capability to portray a wide range of cartographically significant features. Although drainage, vegetation, urban areas, bridge, powerline, and obstruction information are available in the file,

lines of communication are not. The original application of DLMS was medium resolution radar simulation. As these sensors could not resolve roads or railroads, there was no requirement to collect them. New applications for DFAD, however, will require these features to be collected.

Production of the DTED and DFAD files is a relatively expensive, time consuming effort. DFAD is a particularly expensive product due to extensive feature interpretation which, at this time, is a largely manual operation. DTED is less costly due to its relative simplicity. DTED can be collected by two methods. Data produced during the 1970's were compiled from existing 1:250,000 map sheets. Map contours were either digitized by hand or with a flying spot scanner. An increasing percentage of DMA's terrain data is now being derived by photogrammetric methods. In this case, terrain matrices are developed directly from a stereo model with the use of sophisticated analytical compilation equipment. To improve quality control terrain data are being further enhanced by the digitizing of ridgelines and drainage patterns which prevents truncated depiction of high and low points in the terrain. Currently, all production of DFAD is done through the interpretation of photographic sources.

IV. DLMS ENHANCEMENTS

DMA recognizes the fact that its DLMS data base, conceived as a radar simulation product, is not the optimal solution for a multi-use, digital mapping file. The Agency is attempting to enhance the capability of the data base by increasing the accuracy, content, and coverage of both the terrain and feature files. In the case of DTED, we are undertaking a systematic maintenance program which will replace the majority of the map-derived DTED with photo-produced DTED by 1988. This will substantially increase overall file accuracy. Deficiencies in the DFAD are being addressed by the implementation of a Second Edition specification during 1984 which will include the collection of roads, railroads, and enhanced drainage patterns. This will increase the utility of the DFAD for requirements such as high resolution sensor simulation, C3I and situation map displays.

A major concern to DMA is that it cannot produce enough feature data against the current specification to meet the valid requirements of the user community. Current projections put completion of the stated DFAD requirement around the year 2000. In order to get sufficient data into the file to meet operational needs, DMA is initiating production of a new, simplified feature file, Level-1C, for use in areas of low cultural density. Level-1C data consist of feature information derived from 1:250,000 map source with supplemental input from LANDSAT data. Level-1C is intended to be a low cost supplement to, not a replacement for, standard DFAD. Without the extensive feature analysis required by DFAD specifications, Level-1C data can be produced at 15% of the cost. However, Level-1C data have not yet been accepted by the entire user community.

In addition, DMA will initiate an active, ongoing

program of technical assistance to system developers requiring digital data to promote maximum compatibility early in the R&D cycle. However, before establishing such support, Service headquarters will validate their subordinate commands' requests for technical assistance using current service directives.

DMA has revised its digital data distribution policy in order to more effectively supply digital data to the user community. A DMA instruction has been issued allowing direct user interface with the production centers for the acquisition of standard digital data. DMA will also provide a sample data set to Service R&D labs which can be used for test and evaluation purposes.

DMA is currently working with the Services and OSD to formulate a DoD policy on transformation of standard digital MC&G data bases to meet the unique requirements of individual weapon systems. The flexibility of digital data which allows almost unlimited manipulation and processing has blurred the traditional definition of map products. Consequently, a consensus agreement is needed which defines the extent to which DMA is expected to transform its digital data.

V. FUTURE DIRECTIONS

Whereas DFAD Second Edition and Level-1C are aimed at near-term expediencies of the DLMS data base in the 1984-1990 timeframe, a more comprehensive approach to a multi-use digital MC&G data base is required to support out-year requirements. DMA is currently developing a specification which can be utilized to produce a wide range of feature oriented, digital MC&G products. The DMA Feature File (DMAFF) is intended to provide a foundation upon which a family of digital map products can be built using common feature and attribute identifiers as a first step towards a "universal" MC&G data base.

As currently conceived, DMAFF would provide the inherent flexibility and utility required to collect, store, maintain, and exchange digital data with a greater degree of commonality and uniformity. Current DMA products utilize totally different specifications concerning content, accuracy, and resolution for each application. DMAFF will provide a rule base for common identifications of features and attributes across all product lines. DMAFF does not attempt to define specific collection criteria such as accuracy and size. These will still be driven by individual requirements. At this time, DMAFF does not prescribe a data base format, as it should be adaptable to any given structure. DMAFF should, however, provide a level of standardization which can substantially increase DMA's capability to produce a wider range of digital MC&G products.

To support post-1990 advanced system requirements, a major reconfiguration of DMA digital products is necessary. Content of the current DFAD data base will not satisfy the requirements of users in the next decade. Enhancements are needed in such areas as hydrography, flight information, feature resolution, and positioning accuracy.

The internal DMA requirements for digital production systems and automated cartographic products will also drive major changes in our current digital effort engaged. DMA is currently in an active program to develop digital products capable of supporting these sophisticated applications.

In this respect, Level V, Level X, and the High Resolution Data Base are designed to store DLMS type data at a higher density level in support of weapon systems guidance and simulation systems. In addition, a Terrain Analysis Data Base is being developed to support ground operations including troop and vehicular movement.

The Prototype Level V, Level X and High Resolution/Terrain Analysis Data bases, currently under evaluation by the user community, constitute DMA's applications test bed for a long term approach to advanced systems support. The purpose of these prototypes is to assist the Services in the definition of content requirements for next generation data bases, while concurrently providing valuable "hands on" experience in the use of advanced digital MC&G data. While DMA does not intend to put these prototypes into general production, a vigorous evaluation program will continue.

DMA will utilize user comments on the suitability of the products to define the feature content required for operational support of high resolution simulation and automated terrain analysis.

VI. DMA SUPPORT

DMA Welcomes the opportunity to assist those

users working with our products in support of valid government programs. Service labs and SPUs and their contractors are permitted direct access to DMA on technical issues, such as data base content, availability and quality. The DMA Requirements Division is responsible for providing support to the MC&G user and will assist you in every way possible. Our address is as follows:

DMA(PPR)
Bldg 56, US Naval Observatory
Washington, D.C. 20305
(202) 653-1453, AV 295-1453

Requirements for product support from DMA must be tendered through appropriate Service staff or U.S. Command channels. This includes requests for all digital MC&G products and their accompanying documentation. The following Service MC&G points of contact must be utilized by Air Force, Army, and Navy elements respectively when requesting DMA product support:

AFIS(INTB)
Bolling AFB
Washington, D.C. 20332
(202) 767-4481, AV 297-4481

DAM1(ISP)
Department of the Army
Washington, D.C. 20330
(202) 695-5509, AV 225-5509

Chief of Naval Operations
OP-952
Washington, D.C. 20305
(202) 653-1610, AV 294-1610

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